

(Nishida et al. 2000). This is consistent with the findings of Krall et al. (1997), who showed that calcium supplementation in postmenopausal women with deficient calcium intake protected against tooth loss.

Oral and Pharyngeal Cancers. High intakes of pickled vegetables, salted meat and fish, spicy foods, charcoal-grilled meat, and beverages served at very high temperatures have been found to be associated with oral cancers in some countries (Winn 1995). Malnutrition has also been found in association with the diagnosis of oral and pharyngeal cancers (Bassett and Dobie 1983). Whether the malnutrition was the cause or the effect is not clear.

Oral Cancer Prevention. A consistent finding across numerous studies is that a diet high in fruit and vegetables is associated with a reduced risk of oral cancer even when smoking and alcohol intake are taken into account (Steinmetz and Potter 1996). In a case-control study, risk of second primary tumors in oral and pharyngeal cancer patients was reduced in those with a high vegetable intake (Day et al. 1994). Fruits and vegetables contain fiber, carotenoids, and vitamin C, which may be important in cancer chemoprevention. Vitamin C may act as an antioxidant, protecting cell membranes and DNA from oxidative damage. Lack of vitamin C may interfere with collagen synthesis and permit tumor growth. Green leafy vegetables contain lutein, a carotenoid, xanthophyll, an antioxidant, and folic acid. Folic acid deficiency may interfere with DNA methylation and DNA repair (Winn 1995). The only prospective cohort study of diet and oral cancer (>25,000 persons in Maryland) showed that high serum total carotenoids and alpha tocopherol (vitamin E) reduced the risk of oral cancer, but high serum gamma tocopherol and selenium increased cancer risk (Zheng et al. 1993). The use of retinoids and β -carotene in controlled therapeutic doses shows protective effects. Fewer new primary tumors in persons with previous oral cancers and reversal or reduction in size of premalignant lesions have been reported (Khuri et al. 1997, Papadimitrakopoulou and Hong 1997). For example, high doses of 13-*cis*-retinoic acid, though causing significant toxicities, have been effective in the treatment of oral leukoplakia (Hong et al. 1990).

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teeth, firm gums, healthy soft tissues, well-functioning bites, and beautiful smiles—but many do not.

One in every four U.S. children today is born into poverty (U.S. Bureau of the Census 1998b) with all of its associated barriers and constraints. Poverty is a key indicator of poor oral health status among children (Litt et al. 1995). Poor children suffer twice as much dental caries as their more affluent peers (Vargas et al. 1998). Studies have shown that the children with the most advanced oral disease are primarily found among America's most vulnerable groups: the poor, American Indians and other minorities, homeless and migrant populations, children with disabilities, and children with HIV (Isman and Isman 1997).

If untreated, oral diseases in children frequently lead to serious general health problems and significant pain, interference with eating, overuse of emergency rooms, and lost school time (Edmunds and Coye 1998). It has been estimated that 51 million school hours per year are lost because of dental-related illness alone (Gift 1997).

The Institute of Medicine reports that 70 percent of U.S. children are generally healthy and require only regular preventive and intermittent medical services. Twenty percent experience chronic problems, which may impose significant limitations on their ability to function effectively and require regular treatments for their conditions. Only the remaining 10 percent suffer from severe chronic conditions necessitating intensive health services (Edmunds and Coye 1998).

Similarly, the vast majority of America's children today enjoy excellent oral health, but a significant subset of children experience a high level of oral disease. Although it is no longer unusual to see children smiling with a full set of unmarred teeth, millions of other children have little to smile about. For them, the daily reality is persistent dental pain, endurance of dental abscesses, inability to eat comfortably or chew well, embarrassment at discolored and damaged teeth, and distraction from play and learning.

Like asthma, learning difficulties, and social problems, dental caries is highly correlated with low income, limited education, and social disadvantage. In this regard, it may serve as a sentinel disease for other pediatric conditions that are related to inadequate diet and hygiene and to family conditions and a social environment that do not support healthy lifestyles.

Some oral conditions, like other childhood illnesses, affect children randomly, regardless of social or economic status. Such conditions include cleft lip and palate and other craniofacial developmental dis-

orders, malocclusion, and unintentional injuries. Other oral conditions in children such as mucosal lesions may be a sign of risk behaviors such as tobacco use. All oral conditions may be exacerbated in children with other special health care needs.

Adults concerned about the health of children, particularly low-income and minority children, are regularly confronted by the reality and consequences of unmet oral health care needs. Although often viewed as innocuous by those who enjoy excellent dental health or have ready access to dental care, dental and oral problems impact the very life experience of affected children. Chronically poor oral health is associated with diminished growth in toddlers (Acs et al. 1992, Ayhan et al. 1996) and compromised nutrition (Acs et al. 1999). Dental disease in children also takes a personal and social toll. Observing disadvantaged inner-city schoolchildren, Kozol (1991) noted, "although dental problems don't command the instant fears associated with low birth weight, fetal death, or cholera, they do have the consequences of wearing down the stamina of children and defeating their ambitions."

In addition to the millions of children with extreme dental problems, many times more encounter more modest disease. For example, the review of the Healthy People 2000 objectives found that more than half of all second graders, children aged 6 to 8, still experience cavities (USDHHS 1997). Dental caries remains the single most common disease of childhood that is neither self-limiting, like the common cold, nor amenable to a simple course of antibiotics, like an ear infection (Edelstein and Douglass 1995).

The numbers of poor and minority children are increasing faster than other socioeconomic subsets of U.S. children (Waldman 1996), and dental caries is common in these children. Twenty-five percent of these children have never visited a dentist before entering kindergarten (USDHHS 1997), despite widespread understanding that the dental caries process is established before age 2 and the recommendation of experts that children as young as 1 may benefit from a dental visit (AAPD 1997, Green 1994, USDHHS 2000). Parents are consistently concerned about the dental needs of their children (Simpson et al. 1997), and studies conducted in hospital emergency rooms have found extensive dental needs among children (Sheller et al. 1997, Unkel et al. 1989, Wilson et al. 1997). Dental care has recently been noted as the most prevalent unmet health need among American children (Newacheck et al. 2000). These conditions are evident despite the advances in the oral health sciences and the growing capacity of

oral health care providers to prevent common pediatric oral diseases.

Children with disabilities present unique problems and are at increased risk for oral infections, delays in tooth eruption, periodontal disease, enamel irregularities, and moderate-to-severe malocclusion (Isman and Isman 1997). Their exposure to certain medications and therapies, special diets, and their difficulty in maintaining daily hygiene further compromise their oral health (Casamassimo 1996). Also, access to professional care is a particular problem for these children (see Chapter 4). Guides for dental professionals serving children with special health care needs are under development (USC 1999).

The Role of Insurance in Children's Oral Health

Disparities also occur in access to care. Medical insurance is a strong predictor of access to dental care. Children with no medical insurance are 2.5 times less likely than insured children to receive dental care (Bloom et al. 1992, Monheit and Cunningham 1992, Newacheck et al. 1997). Children with no dental insurance were 3.0 times more likely to have an unmet dental need than their counterparts with either public or private insurance (Newacheck et al. 2000, Waldman 1998). Dentists daily observe that insured children are more likely to obtain comprehensive, continuous, and coordinated care and are more likely to be followed regularly for semiannual preventive visits. It has long been recognized that dental plans with low cost-sharing requirements are likely to improve the oral health of young people, especially those with the poorest oral health (Bailit et al. 1985).

Children's general health also affects access to dental care. Children with "fair or poor" general health have nearly twice the unmet dental needs as children with "good or excellent" health, according to their parents (Simpson et al. 1997). As income rises, unmet treatment needs drop off dramatically. Children from families with annual incomes of \$10,000 to \$20,000 have 10 times more unmet dental needs than children whose families earn more than \$50,000 per year (Simpson et al. 1997).

White children are more likely than children in other ethnic and racial groups to have private dental insurance coverage. When last surveyed nationally in 1989, about half (52 percent) of white children had dental insurance, compared to only 39 percent of black children and 32 percent of Mexican American children. As family incomes increase, children are more likely to be covered by dental insurance (USDHHS 1992).

In the United States, most health insurance is provided through the workplace, and about 60 percent of children are covered by private health insurance through their parents' plans (U.S. Bureau of the Census 1998a). A smaller percentage, about 31 percent, enjoy dental insurance as well. There are at least 2.6 children without dental insurance for each child without medical insurance (Vargas et al. 2000).

Over the last decade, employer-based coverage for children has eroded, while publicly funded health insurance through Medicaid and the State Children's Health Insurance Program (SCHIP) has expanded to cover over 25 percent of all children (U.S. Bureau of the Census 1998a). The Congressional Budget Office estimates that 2.5 million children will be insured through SCHIP. However, even with this increase many children will remain without dental coverage.

Properly funded dental insurance works. When commercial-style, state-funded dental coverage became available to modest-income families in western Pennsylvania, the percentage of previously uninsured children (uninsured for more than 6 months) who saw a dentist during one year of coverage increased from 30 to 64 percent. The percentage of parents who reported that their child had a regular source of dental care increased from 51 to 86 percent. The percentage of parents who claimed that their children had unmet or delayed dental needs decreased from 52 to 10 percent. In addition, the number of dental visits fell as children's acute and episodic care decreased and they began programs of regular preventive and maintenance care (Lave et al. 1998).

Publicly Funded Insurance for Children

Medicaid. Although publicly funded programs such as Medicaid have succeeded dramatically in providing a "medical home" and regular medical care to children from low-income families (Newacheck et al. 1997), Medicaid's record of ensuring regular access to dentists and providing effective dental care is less successful. Fewer than one in five Medicaid-covered children received a single preventive dental visit during a recent year-long study period, according to the U.S. Inspector General (USDHHS 1996). The study indicated that three fourths of states provided preventive services to fewer than 30 percent of eligible children, and no state provided preventive dental care to more than 50 percent of all eligible children. More disturbing is the finding that few Medicaid children who receive dental care get any services beyond a cleaning and fluoride treatment, despite their need for dental repair and fillings (Solomon 1998).

Federal legislation enacted over three decades ago established a guarantee of dental care to Medicaid-eligible children through the Early and Periodic Screening, Diagnostic and Treatment Service (EPSDT; P.L. 90-284). Final regulations, effective in early 1972 (U.S. Bureau of the Census 1998a), ensure comprehensive dental services—prevention, diagnosis, and treatment for “teeth and associated structures of the oral cavity and disease, injury or impairment that may affect the oral or general health of the recipient”—and promise children access to dental services of sufficient “amount, duration, and scope” to ensure oral health. Federal law also requires provision of enabling services such as transportation and translation. In addition, revisions to the Social Security Act in 1989 (OBRA 89) made several changes to EPSDT services. States are now required to set a distinct periodicity schedule for the provision of dental services after consultation with recognized dental organizations involved in child health care. States are also required to provide any medically necessary dental service coverable under Medicaid to an EPSDT eligible child even if the service is not available to individuals age 21 and older under the Medicaid state plan. Despite these laws and regulations, inadequate funding, chronically poor payments to dentists, administrative burdens, and beneficiary utilization patterns have limited the effectiveness of this program (USDHHS 1996).

Increasingly, states are electing to purchase dental care for low-income populations through managed care organizations rather than to pay providers directly for Medicaid. As states take on the role of purchasers of care rather than claims payers, their focus has turned to a concern for health outcomes. However, participation of dentists in managed care programs is low (AAPD 1997, ADA 1998b, NADP 1998), and the effort to move dental Medicaid care into managed care programs may further constrain the availability of care.

A 1998 survey of state Medicaid authorities by the National Conference of State Legislatures reported that, on average, only 16 percent of dentists in the 35 responding states participate actively in Medicaid (i.e., were compensated more than \$10,000 in the preceding 12 months for dental care to Medicaid-enrolled patients). In 24 of these 35 states, fewer than 20 percent of active dentists participate actively (Guiden 1998). The study also raised awareness that common Medicaid payment rates for five typical children's dental procedures rarely exceed 65 to 70 percent of dentists' usual fees (Guiden 1998), a percentage that represents dentists' typical overhead

costs in delivering those services (ADA 1998b). A 1998 federally sponsored national meeting, “Building Partnerships to Improve Children's Access to Medicaid Oral Health Services,” also identified inadequate payments to dentists among multiple barriers in Medicaid program administration. Barriers identified by the conference were categorized as financing and funding issues, Medicaid policies and administrative procedures, supply and distribution of providers, parental valuation of oral health, and lack of a systematic approach to identifying and promoting successful interventions (Spizak and Holt 1999).

Medicaid expenditures for dental care are low. On average, state Medicaid agencies contribute only 2.3 percent of their child health expenditures to dental care (Yudkowsky and Tang 1997), whereas nationally, the percentage of all child health expenditures dedicated to dental care is more than 10 times that rate, almost 30 percent (Lewit and Monheit 1992). A 1998 actuarial study of health care costs for children (AAP 1998) calculated that 21 percent of expenditures for a comprehensive package of health services (including inpatient, outpatient, mental, dental, vision, hearing, and pharmacy services, but excluding orthodontic care) should be dedicated to dentists' services. This study suggests that fully \$21.35 per child per month must be expended in order to meet the dental care needs of covered children. A similar study conducted by the Reforming States Group (1999) determined that \$17 to \$18 per child per month is a necessary expenditure for dental care, assuming that providers accept a modest discount on their fees when serving low-income children. In FY 1995, Medicaid expended only \$4.44 per enrolled child per month (Yudkowsky and Tang 1997).

Although states vary widely in the percentage of children covered by Medicaid and in the income levels they require for eligibility, all states must entitle child beneficiaries to comprehensive dental services under EPSDT. A review of 15 state oral health and dental access surveys (Tinanoff 1998) noted the following recurrent themes about Medicaid in relation to children's oral health:

- States show similar dental care issues for Medicaid-enrolled children: high disease prevalence, low provider participation, and insufficient funding.
- Children at the highest risk of having dental caries are the least likely to have access to regular dental care.
- Barriers to provider participation include low reimbursement rates in a health care environment that has high overhead; perception of administrative

problems with Medicaid programs; and patients who do not fit the expectations of the dentist.

- Medicaid payments for dental care account for less than 3 percent of total state Medicaid child health expenditures in these states.
- The percentage of EPSDT eligibles with a dental visit (an initial measure of access to care) fails to reflect the insufficiency of reparative care to meet children's acute dental health needs.
- Lack of access to dental services for Medicaid recipients is perceived as the greatest pediatric health care problem in many states.
- Untreated dental problems get progressively worse and ultimately require more expensive interventions, often in a hospital emergency room or operating room.

State Children's Health Insurance Program. Thirty years after enacting Medicaid, the U.S. Congress in 1997 addressed the lack of medical coverage for over 10 million additional children by passing the State Children's Health Insurance Program (SCHIP). The Congressional Budget Office anticipates that this program will extend health insurance to at least 2.5 million more children and in the process will identify many additional children who are eligible for, but not enrolled in, Medicaid. SCHIP complements the Medicaid program by providing health insurance to children whose family income is above Medicaid eligibility standards, generally up to 200 percent of the federal poverty level. SCHIP differs from Medicaid in that it is not an individual entitlement, and states have broad latitude in designing and implementing insurance programs for modest-income children.

The law provides no direct mandate regarding services to be covered beyond immunizations and well-baby, well-child care. Dental coverage is specifically cited as one of 28 services that can be funded with SCHIP dollars. Although states are not required to provide dental coverage, congressional report language and presidential pronouncements are explicit in emphasizing the need for dental care (ADA 1998a,b). Prior to signing the bill in August 1998, President Clinton stated, "it is important that we have an adequate benefit package for children, recognizing that there are some problems that children have in a way that is more profound than adults, including problems with vision, with hearing and with dental health." Upon signing the bill, he said, "Because we have acted, millions of children all across the country will be able to get medicine, and have their sight and hearing tested and see dentists and doctors for the first time."

States can elect to apply federal SCHIP funds to expand Medicaid or they may use one of four options to provide services under a separate SCHIP program: 1) develop a new state program based on benchmark coverage, which is state employee coverage; 2) provide coverage under the SCHIP using benchmark-equivalent health coverage, which requires the use of an actuarial report to determine that coverage is at least equivalent to one of the benchmark plans; 3) apply existing comprehensive state-based coverage available in New York, Florida, and Pennsylvania; and 4) seek Secretary-approved coverage. Only 2 (Delaware and Colorado) of 56 states and territories have not included substantial dental care for most children covered by SCHIP. States implementing SCHIP have expanded access to dental care services through a variety of mechanisms. Expanding coverage through Medicaid ensures that newly enrolled children are entitled to dental coverage, although these children face the same barriers as other Medicaid children, as discussed previously. Even with current levels of commercial dental insurance and improved access through Medicaid and the new SCHIP program, almost one quarter of children will remain without dental coverage.

The Social and Professional Environment for Prevention

Although science continues to reveal new opportunities to prevent disease and promote health, sufficient understanding already exists to significantly reduce common oral diseases for all children. One of the most critical findings is that effective prevention requires an early start.

The American Academy of Pediatric Dentistry (AAPD 1997), the American Dental Association (ADA 1997), and the Bright Futures health supervision consensus project (Green 1994) all recommend that a toddler be seen by a dental professional at 12 months of age for an initial examination and risk assessment for common oral diseases and injuries. This first visit provides an opportunity for parents to learn about multiple oral health issues—dental caries, periodontal health, injury prevention, dental development, oral habits, common soft tissue sores, and bite development—as well as how to promote their child's complete oral health (Nowak 1997). Despite professional guidance and a Healthy People 2000 goal that 90 percent of children be seen by a dentist before entering kindergarten, only 63 percent of children have a dental visit before starting school (USDHHS 1997).

Because growth and development is so predictable, it can be anticipated and guided through education and carefully timed interventions. Applied to oral health, "anticipatory guidance" allows parents, children, and institutions to learn the stages of oral, facial, and dental development and how to care for the next stage of development (Nowak and Casamassimo 1995). Tables 10.2, 10.3, 10.4, and 10.5 provide examples of the risk and risk reduction methods related to periodontal diseases, dental caries, malocclusion, and injury, respectively (Casamassimo 1996). Physical, behavioral, socioenvironmental, and disease and treatment-related factors are addressed.

Anticipatory guidance allows the parent, dental team, other health care providers, and institutions that care for the child to ensure a child's good oral health, avoiding preventable pitfalls and problems by knowing how a child's mouth changes over time. For example, prevention of early childhood caries requires guidance to caregivers before the child's teeth erupt to prevent or limit the transmission of microbial infections from mother to child and to promote appropriate feeding practices even *before* the child has any teeth in place (Grindefjord et al. 1995, Kohler et al. 1984, 1988, Li and Caufield 1995, Tanzer 1995). Similarly, anticipatory guidance for oral health extends to safeguarding a house to prevent oral burns and injuries and to teach parents about the dangers of foreign objects in the mouths of toddlers and preschoolers. Anticipating a young person's interest in sports requiring mouth guards or head protection, discouraging smoking and smokeless tobacco before they are first used, and encouraging teens to adopt hygiene practices that prevent periodontal disease initiation also are examples of guidelines that need to be addressed by all individuals and organizations responsible for the child.

There is promise for further eradication of common childhood dental and oral infections. Education regarding oral infections in mothers and caregivers can con-

tribute to the infant's or toddler's general and oral health. Current investigations suggest that pathogenic exposures can be limited, children's resistance to acquiring disease-causing bacteria can be enhanced, physical and chemical barriers to transmission can be erected, and early-stage disease can be reversed with medications. Importantly, there is no one-size-fits-all solution to disease prevention and suppression. Most acquired dental and oral disease of childhood is preventable. The challenge today is to bring the promise of prevention to the most vulnerable of our children and youth. Meeting the challenge will require enhancing programs such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), Head Start, along with early child care, and community and school-based centers.

Families have the capacity to support healthy oral health practices, as well as to support and

TABLE 10.2
Risk and protective factors for periodontal diseases

Risk Factors	Risk Reduction Methods
Physical Examples	
Anatomical variations (e.g., frenum)	Surgical correction
Malpositioned and crowded teeth	Orthodontic care
Gingivitis	Treatment of disease
Puberty	Preventive measures to address oral effects
Pregnancy	Preventive measures to address oral effects
Mouthbreathing	Management of mouthbreathing
Genetic predisposition (e.g., Down or Papillon Lefevre syndrome)	Preventive intervention to minimize effects
Behavioral Examples	
Inadequate oral hygiene	Improved oral hygiene
Tobacco use	Tobacco cessation
Socioenvironmental Examples	
Poor oral health and hygiene	Access to care and improved oral hygiene
Poverty	Access to care
Disease- or Treatment-related Examples	
Injury	Use of age-appropriate safety measures and treatment of injury
Nutritional deficiencies (e.g., vitamin C)	Healthy eating habits
Metabolic disease (e.g., diabetes, hypophosphatasia)	Treatment of disease
Neoplastic disease (e.g., leukemia or its treatment)	Treatment of disease and preventive intervention to minimize effects
Infectious disease (e.g., HIV/AIDS)	Treatment of disease and preventive intervention to minimize effects
Medications (e.g., Dilantin)	Preventive intervention to minimize effects
Poor-quality restorations	Restoration of carious lesions
Unrestored carious lesions	Properly contoured and finished restorations

Source: Modified from Casamassimo 1996.

encourage behaviors conducive to health and well-being, no matter their income. Communities that recognize children's oral health as an important public good can provide resources and ensure services, ranging from sealant programs, school education, and fluoridation programs to candy-free aisles in grocery stores and merchant campaigns to combat teen smoking and drinking.

At the state and federal levels, however, the good intentions of legislation have fallen short of adequate implementation. Nevertheless, by linking the power of growth and development with health promotion activities, the nation has the potential to bring excellent oral health to all children.

Health promotion covers a spectrum of efforts: anticipating problems, preventing them from occurring, and suppressing them when they first occur. These efforts can be targeted to individual children or entire communities of children, particularly children at high risk for dental and oral problems.

Adolescents and Young Adults

Data regarding oral health during adolescence and young adulthood are not abundant. However, most teenagers and young adults live healthy and active lives. Indeed, these years represent a peak period of biological fitness. This also is a time when individuals are exposed to and begin behaviors that may place them at risk, such as tobacco and alcohol use and poor dietary practices. For 12- to 17-year-olds who use smokeless (spit) tobacco, for example, 34.9 percent of current snuff users and 19.6 percent of current chewing tobacco users had tobacco-related oral lesions (Tomar et al. 1997). (See Box 10.2 on the effects of tobacco on oral health.) Adolescents become more mobile, traveling independently in cars, motorcycles, and other vehicles, where the use of safety belts and helmets is needed. Sexual practices begin during this time, further exposing individuals to infections that predispose them to general and oral health problems. Ideally, the prevention of risk behaviors begins earlier in life, but this stage of life brings such a cascade of events that even the most informed and well-supported adolescent may find it difficult to adhere to practices recommended by caregivers and institutions.

This period of life also is marked by rapid change as individuals move from school to work to marriage and parenting, possibly relocating far from their birthplace. Many young persons who were fortunate to have health insurance lose their coverage after they leave college or are no longer "dependents." Health status is largely determined by lifestyle behaviors and socioeconomic factors reflecting education, career, and income.

About one third of 15-year-olds have experienced dental caries in their permanent teeth, and another 20 percent have untreated dental decay. Poor adolescents have higher disease rates and more untreated disease. Periodontal diseases, as defined by having 4 mm or more of attachment loss, are seen in about 3 percent of 18- to 24-year-olds, although it is in the

TABLE 10.3
Risk and protective factors for dental caries

Risk Factors	Risk Reduction Methods
Physical Examples	
Variations in tooth enamel; deep pits and fissures; anatomically susceptible areas	Sealants (if possible) or observation
Gastric reflux	Management of condition
High mutans streptococci count	Reduction of mutans streptococci
Special health needs	Preventive intervention to minimize effects
Previous caries experience	Increased frequency of supervision visits
History of baby bottle tooth decay	Increased frequency of supervision visits
Behavioral Examples	
Bottle used at night for sleep or "at will" while awake	Prevention of bottle habit and weaning from bottle by 12 months
Frequent snacking	Reduction in snacking frequency
Inadequate oral hygiene	Improved oral hygiene
Eating disorders, including self-induced vomiting (bulimia)	Referral for counseling
Socioenvironmental Examples	
Inadequate fluoride	Optimal systemic and/or topical fluoride
Poor oral health and hygiene	Access to care and improved oral hygiene
Poverty	Access to care
High parental levels of bacteria (mutans streptococci)	Good parental oral health and hygiene
Diseases or Treatment-related Examples	
Special carbohydrate diet	Preventive intervention to minimize effects
Frequent intake of sugared medications	Alternate medications or preventive intervention to minimize effects
Reduced saliva flow from medication or irradiation	Saliva substitutes
Orthodontic appliances	Good oral hygiene for appliances

Source: Modified from Casamassimo 1996.

TABLE 10.4
Risk and protective factors for malocclusion

Risk Factors	Risk Reduction Methods
Physical Examples	
Congenital absence of teeth	Early intervention
Mouthbreathing	Management of mouthbreathing
Variations in development (e.g., tooth eruption delays and malpositioned teeth)	Early intervention
Muscular imbalances	Early therapy
Familial tendency for malocclusion	Early intervention
Conditions associated with malocclusion (e.g., cleft lip/palate)	Early intervention
Behavioral Examples	
Nonnutritive sucking habits	Elimination of habit
Disease- or Treatment-related Examples	
Injury	Use of age-appropriate safety measures (e.g., car safety seats, safety belts, stair gates, mouth guards) and treatment of injury
Acquired problem from systemic condition or its therapy	Dental intervention as a part of medical care
Loss of space due to caries	Early intervention for caries
Musculoskeletal conditions (e.g., cerebral palsy)	Dental intervention as a part of medical care
Skeletal growth disorders (e.g., renal disease)	Dental intervention as a part of medical care

Source: Modified from Casamassimo 1996.

TABLE 10.5
Risk and protective factors for injury

Risk Factors	Risk Reduction Methods
Physical Examples	
Lack of protective reflexes	Referral for appropriate therapy
Poor coordination	Referral for appropriate therapy
Protruding front teeth	Orthodontic care
Behavioral Examples	
Failure to use safety measures appropriate for infant/child/adolescent (e.g., car safety seats, stair gates, mouth guards, safety belts)	Use of age-appropriate safety measures
Participation in contact sports	Use of protective gear
Socioenvironmental Examples	
Substance abuse in family	Referral for counseling
Substance use by child or adolescent	Referral for counseling
Child abuse or neglect	Referral for counseling
Multiple family problems	Referral for counseling
Disease- or Treatment-related Examples	
Overmedication	Adjustment of medications
Hyperactivity	Management of condition

Source: Modified from Casamassimo 1996.

adolescent years that early-onset periodontitis is first diagnosed. Young non-Hispanic blacks have twice the proportion of periodontal disease than either white or Mexican Americans aged 30 to 49 years. Complete tooth loss is low in this age group, with only an estimated 0.4 percent of individuals aged 18 to 34 years having no teeth (see Chapter 4).

These years also mark the period of life when intentional and unintentional injuries take their greatest toll. Because many of these injuries affect the oral-facial region, they have special relevance to oral health. In particular, the example of oral-facial sports injuries illustrates the roles of behavior and socioeconomic environment as determinants of health, as well as pointing to several actions, such as use of protective head gear and mouth guards, that can serve as correctives.

Midlife Adults

Adults between 35 and 65 have been aptly called “the sandwich generation”—caring simultaneously for aging parents and dependent children, while trying to maintain their own health, careers, and family structure. This population cohort is growing in numbers in parallel with the ever-increasing numbers of the elderly. Although many older Americans will be self-sufficient for the rest of their lives, about one third will require higher levels of care because of chronic or terminal illness.

The demographic nature of these middle-aged adults is complex. In many families, both spouses work and have moved from their birthplaces. Many others have divorced, remarried, moved again, lost or changed jobs, and experienced a variety of midlife crises. Adding to the

BOX 10.2**The Effects of Tobacco on Oral Health**

The use of tobacco products—cigarettes, cigars, pipes, and smokeless (spit) tobacco products (snuff and chewing tobacco)—has emerged as a major preventable risk factor for a number of oral diseases and disorders.

Oral and Pharyngeal Cancers

Cigarettes. Tobacco smoke contains over 4,000 compounds, some of which are carcinogenic, toxic, or mutagenic (USDHHS 1989). An extensive review of the literature has clearly established a causal relationship between cigarette smoking and oral cancer (USDHHS 1982, 1989). Indeed, about 90 percent of oral cancer deaths are attributable to smoking (Shopland 1995, USDHHS 1989), and smoking cessation can significantly reduce the risk (USDHHS 1990).

Smokeless (Spit) Tobacco. These products are causally linked to oral and pharyngeal cancers (IARC 1985, Nash 1986, USDHHS 1986). About 30 carcinogens have been found in spit tobacco, including tobacco-specific N-nitrosamines, benzo[alpha]pyrene, and formaldehyde (Hoffman and Djordjevic 1997). Spit tobacco users have an oral cancer risk 4 to 6 times that of nonusers (Blot et al. 1988, Winn et al. 1981). Characteristic mucosal lesions are associated with spit tobacco use (Axéll et al. 1976, Holmstrup and Pindborg 1988, Peacock et al. 1960, Pindborg and Renstrup 1963) and can be found even among adolescent users (Greer and Poulson 1983, Offenbacher and Weathers 1985, Poulson et al. 1984, Tomar et al. 1997b, Wolfe and Carlos 1987). They are considered potentially premalignant (USDHHS 1986).

Cigars and Pipes. Cigar smoke contains the same toxic and carcinogenic compounds found in cigarette smoke (Hoffmann and Hoffmann 1998). A recent review of case-control and cohort studies also shows a consistent elevation in risk for oral and pharyngeal cancers among cigar smokers, with cigar smokers having 2 to 22 times the risk of non-smokers of cigars (USDHHS 1998). The risk of oral and pharyngeal cancers increases with the number of cigars smoked per day and the depth of inhalation.

Although data for pipe smoking and oral cancer risk are more limited than data for use of other forms of tobacco, relative risk estimates from longitudinal studies are similar for pipe smokers and cigarette smokers (USDHHS 1982, 1989).

Periodontal Diseases

Reviews of the literature have long implicated cigarette smoking as a risk factor for periodontal diseases. More recent studies such as Grossi et al. (1994, 1995) showed that smoking was a major risk factor for periodontal disease in a group of 1,500 adults. Measured either by radiographic bone height or probing attachment level, and after adjusting for age, sex, socioeconomic status, and plaque and calculus levels, the investigators found that smokers were 7 times more likely to develop periodontal disease than nonsmokers. They also found a direct linear dose-response relationship between the level of smoking, assessed by pack years (number of cigarettes smoked per day times years smoked), and destructive periodontitis. Smoking is also

a prognostic indicator: current smokers are at a significantly greater risk for further loss of periodontal attachment than are nonsmokers, with an odds ratio of 5.4 (95 percent confidence interval of 1.5 to 19.5).

Mechanisms explaining the association suggest that smoking depresses immune responses (Holt 1987, Sasagawa et al. 1985), including diminishing white blood cell activity (Gala et al. 1984, Kenney et al. 1977). Toxic and vascular effects as well as effects on the subgingival flora are also suggested. In addition, smokers do not heal as well as nonsmokers after periodontal disease therapy and experience less reduction in levels of periodontal pathogens (Grossi et al. 1997). The negative effects of smoking can be reversed with cessation of tobacco use. After 10 years, former smokers appear to be no more likely than nonsmokers to have severe loss of periodontal attachment (Tomar and Marcus 1998).

Spit Tobacco. Reports indicate that oral tobacco use results in gingival recession at the usual site of snuff or chewing tobacco placement. In a study of adolescent males, Offenbacher and Weathers (1985) found that 60 percent of users had gingival recession, compared with 14 percent of nonusers.

Dental Caries

The strongest evidence for an association of tobacco use and risk for dental caries relates to the use of chewing tobacco and increased risk for root caries. The causative factor relates to the sugar content of the product. Several popular brands of chewing tobacco have high levels of fermentable sugars (between 30 and 60 percent by weight). In a cross-sectional study of older adults in North Carolina, chewing tobacco users had a higher number and percentage of root surfaces affected by caries than those who used other forms of tobacco or had never or formerly used tobacco (Tomar et al. 1997a). This finding was confirmed in an analysis of data from NHANES III (Tomar and Winn 1998).

Trends in Tobacco Use

In 1995, 47 million adults—25 percent of the U.S. adult population—were smokers (CDC 1997). This figure represents a steady decline from the 52 percent of the population reported to be smokers in 1965, the year following the release of the first Surgeon General's Report on Tobacco (Giovinio et al. 1995). The prevalence of smoking in women was 34 percent in 1965, 30 percent in 1979 (Giovinio et al. 1994), and 23 percent in 1995 (CDC 1997).

In contrast, cigarette smoking in adolescents has been increasing. Daily smoking among high school seniors increased from 17 percent in 1992 to 22 percent in 1996 (Johnston et al. 1997). High school students who reported smoking in the preceding month increased from 27.5 percent in 1991 (USDHHS 1994) to 36 percent in 1997 (CDC 1998).

Spit tobacco use has also increased. Sales of moist snuff—the most popular form of spit tobacco used by young people (Tomar et al. 1995)—have increased every year since the mid-1970s (FTC 1997, Maxwell 1992, USDA 1997). About 20 percent of male high school students reported using spit tobacco during the previous month (CDC

(continues)

BOX 10.2 continued

1996, Johnston et al. 1997). About 6 percent of adult males use spit tobacco (CDC 1993). Nearly all regular users are male.

Aggressive marketing has also led to explosive growth of sales and consumption of cigars. Between 1993 and 1997, cigar consumption increased nearly 50 percent (Gerlach et al. 1998). In 1997, 22 percent of high school students smoked at least one cigar in the preceding 30 days (CDC 1998).

Implications of Trends

For Oral and Pharyngeal Cancers. The increases in spit tobacco and cigar use among young people do not bode well for the oral and general health of coming generations of Americans. Over the past 35 years the decline in the incidence and mortality rates of oral cancer has been attributable to declines in cigarette smoking primarily in adult white males. Cigarette smoking among African American males over the same time period was higher. This practice contributed to the higher rates of oral cancer among black males during these years. However, recent studies indicate precipitous declines in smoking among black males, so that their smoking rates are approaching the rates seen in white males (USDHHS 1998). Indeed, figures on smoking among adolescent and younger African American adults have even been lower than those for their white counterparts. These trends could result in substantial reductions in the risk for oral cancer among African Americans, were they to continue. Unfortunately, there is recent evidence that cigarette smoking among African American high school students is increasing (CDC 1998).

For Periodontal Diseases. The growing popularity of cigar smoking may counter the declines in cigarette smoking and maintain the percentage of periodontal disease attributable to tobacco use.

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demands of a spouse and children, the care of older parents contributes yet another strain to caregivers "in the middle." These caregivers are predominantly female and may be dependent on their own income. They may be single and faced with dealing with their own "passages" (Sheehy 1984).

The baby boomers will be the first U.S. generation to age while maintaining their natural dentition. They are the first to benefit from the caries preventive effect of widespread community water fluoridation and fluoride dentifrices. As a result, the baby

boomers bring to the aging process higher expectations about oral health throughout the lifecycle.

Maintaining the family's oral health may require as many individual solutions as there are sandwich generation members (Sanders 1997, Stern 1994, Warner 1995). Healthy lifestyle decisions combined with preventive measures at home will be as important as regular professional care.

In addition to their own oral hygiene practices, a key component of maintaining the oral health of midlife Americans is the availability of dental bene-

fits. Six of 10 full-time employees are offered dental benefits by their employers, according to a survey by the U.S. Bureau of Labor Statistics ([www.e-dental.com/Virtual Community for the Dental Industry](http://www.e-dental.com/VirtualCommunityfortheDentalIndustry), 12/30/99). These data are from a 1997 survey of firms with 100 or more employees in private nonagricultural industries and are representative of benefits available to 46 million workers. The dental benefits, one of the less prevalent benefits for employees, vary by occupation group and are higher for professional and technical employees (64 percent) than for blue-collar or service employees (56 percent). Among the estimated 22.6 million employees with employer-provided dental benefits, most employees (81 percent) receive their care from traditional fee-for-service plans; 11 percent, from preferred provider organizations; and 8 percent, from health maintenance organizations.

Ensuring the oral health of the middle-aged generation must take into account the shifting patterns of need and the family's ability to cope, the education and training of health care workers about geriatric and family issues, general comprehensive community education programs about aging, estate and taxation issues, housing, and social policies and programs that support all individuals in their quest for self-sufficiency and individual responsibility.

Older Americans

Continued growth of the population 65 and older will have profound effects on health care in the twenty-first century (National Institute on Aging 1997). By 1994 the number of persons 65 and older had grown to 33.2 million and represented 13 percent of the population. Although the total U.S. population is expected to increase by 42 percent over the next half century, the number of men and women 65 and older will increase by 126 percent, those 85 and older by 316 percent, and centenarians by 956 percent—nearly 10 times the present number.

The baby boom generation currently makes up almost one third of the U.S. population. By 2011, when these men and women reach 65, they will swell the ranks of older Americans and significantly burden health care programs and organizations responsive to the needs of older Americans (National Institute on Aging 1997). Although members of this generation can look forward to continued good oral and general health, the challenge will be in providing effective oral health care for those who are not in good health, especially the oldest old, and those with limited financial support.

Oral Health Status

Chapter 4 provides selected oral health data for older Americans as a whole. There is great heterogeneity in oral health status among older Americans. The extent and severity of oral conditions varies across subpopulations of this age group, and many have unmet treatment needs. Even so, older Americans are retaining their teeth more than ever before and hence remain subject to oral diseases and disorders (Douglass et al. 1998). Indeed, with more teeth at risk, there will be an increase in coronal and especially root caries among the elderly, as well as periodontal diseases and inadequate or absent prostheses (Burt 1992). Oral and pharyngeal cancers are primarily diagnosed in older Americans.

For a closer look at the oral health of both institutionalized and homebound elderly, Dolan and Atchison (1993) compiled data based on a comprehensive review of the literature. Although the long-term care population is easily accessible in large groups, oral examinations for research purposes can be challenging. Patient consent and antibiotic premedication are issues, as well as the fact that convenience samples must be used because many patients are unable to cooperate. The authors' summaries of oral health status and perceived needs based on the most comprehensive homebound and long-term care oral health surveys are shown in Tables 10.6 and 10.7, respectively.

Table 10.6 describes eight studies, with 31 to 289 patients, with edentulous rates ranging from 23.8 to 62 percent. In these studies use of dental services within the past year ranged from 8 to 100 percent. In a 1994 Home Health and Hospice survey, only 1 percent of patients reported having a dental visit during that year (Dey 1996). Forty-three to 83 percent of persons in six of the homebound studies in Table 10.6 recognized that they had dental problems.

In the long-term care studies listed in Table 10.7, 45 to 65 percent of those surveyed were completely without their natural teeth. One study found that 17 percent required immediate or emergency dental care. By any standards in the United States, a high degree of dental disease and dental care needs was recognized in all four studies presented.

Daily oral care is an important and easily neglected service that should be offered to this population. Unlike many of the inevitable declines the frail elderly face with their various diagnoses, the decline in oral health can be stayed with good daily oral care. Nursing staff participation in the daily oral care of long-term care patients is crucial. Mouth care is often

considered an unpleasant task and is often delegated to nursing auxiliaries, who have even less oral health training than registered nursing staff. Seventy percent of patients in long-term care facilities had unacceptable levels of oral hygiene (Kiyak et al. 1993, McIntyre et al. 1986).

Barriers to such needed care include lack of knowledge about oral care by the nursing staff, perceived lack of time for care, and lack of perceived need for daily oral care by both caregivers and patients. The resulting failure to provide daily oral

care will often doom oral health that had been previously well maintained.

Data on the oral health status of hospice patients are scarce. Although not all hospice patients are elderly, data from the 1994 Home and Hospice Care Survey showed that 19.8 percent of those in hospice care wore dentures. The terminally ill often suffer from taste alterations, oral soreness, oral dryness, and oral candidiasis or thrush (Aldred et al. 1991). In most cases, the caregiver will perform daily oral care and palliative oral care measures. Palliative care can

TABLE 10.6

Summary of published reports and abstracts on the oral health status and barriers to dental care for homebound elders

	Sample Size	Sample Description	Mean Age (years)	Dental Utilization	Percentage Edentulous	Findings
Steifel et al. 1979	64	Two nonprofit visiting nurse services, Seattle	Approx. 75	25% visit in past year	Approx. 60%	60% reported dental needs; dentate subjects more likely to seek care Barrier: transportation
Yellowitz et al. 1988 [abstract]	107	Recipients of visiting nurse services, Utah	NA	34% visit in past year	NA	>50% reported mouth discomfort, painful tongue, dry mouth, difficulty chewing
Kaste et al. 1989 [abstract], Marcus et al. 1989 [abstract]	289	Homebound, >65 years, recipients of home care services, Boston	82.5	50% with no visit in 10 years	62%	43% perceived dental need Barriers: transportation, cost, needed physical assistance
Aponte-Merced et al. 1990 [abstract]	50	Recipients of home health services, county health departments, Alabama	79.0	8% visit in past year 28% no visit in 20 years	59%	37% had dental complaint; 60% perceived dental need; 84% wanted treatment
Strayer et al. 1990 [abstract], Strayer et al. 1991 [abstract]	67	Clients of urban social service agency, 60% homebound	NA	Not reported	44%	80% perceived dental need Barriers: transportation, cost, physical impairments
Yellowitz et al. 1991 [abstract]	123	Recipients, veterans hospital-based home care, Denver and Minneapolis	72.2	40% visit in past year	33%	50% reported dental health fair/poor; 50-83% perceived dental need Barriers: 53% no perceived need; 25% had no dentist; 22% transportation; 22% cost
Strayer and Ibrahim 1991	31	Chart audit, patients treated at Ohio State University	74.8	100%	23.8%	59.7% had periodontal/preventive/operative needs;
Williams and Butters 1992		Statewide survey to identify the number of homebound persons in Kentucky	68.6	53.8% visit in past year	NA	27.3% prosthodontic needs; 46.8% surgical needs; 2.7% of Kentucky households have a homebound resident

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include oral moisturizers such as artificial saliva, ice chips, a water atomizer, daily oral-cleaning or swabbing, and, if needed, treatment for yeast to relieve oral pain.

Americans have the potential to experience a lifetime of oral health rather than a lifetime of oral restorative care. Each of the following questions can be applied to the major oral problems of the elderly,

TABLE 10.7
Summary of four published reports on the oral health status and barriers to dental care for nursing home residents

	Sample Description	Mean Age (years)	Dental Utilization	Percentage Edentulous	Findings
Empy et al. 1983	242 residents of 12 skilled nursing facilities; stratified random sample; Washington state	81	mean time since last dental visit: 4.9 years	65.3%	Needing denture treatment: urban, semirural, rural; 63, 46, 39%, respectively Mean number of decayed teeth: 1.8, 3.0, 2.4, respectively Mean number of periodontally involved teeth: 1.9, 0.7, 1.1, respectively 80% who did not intend to visit dentist felt "no need" Median age of dentures: 15.5 years
California Dental Association (CDA) 1986	286 residents of a stratified random sample of nursing homes	81	22% visit in past year	57%	17% had immediate dental needs Dentate residents: mean number teeth: 17 12.9% carious 7.0% fractured 49.6% periodontal disease 75.8% needed 1+ quadrants scaling Prosthodontic needs: 25% maxilla, 28% mandible Reasons for not seeking care: 52% felt no need; 24% transportation; 9% finances, 9% illness; 43% oral mucosal disease
Veterans Administration (VA) 1989	634 residents of six VA facilities: Florida, Illinois, Massachusetts; regional convenience sample	71	Not reported	50%	Dentate residents: 3.7 decayed coronal surfaces (DFS = 18.6) 4.8 decayed root surfaces (DFS = 6.5) Average periodontal attachment loss: 2.5 mm, 27% pockets >4 mm Prosthodontic needs: 35% maxilla, 28% mandible 40% denture-related oral lesions
Kiyak et al. 1993	1,063 residents of 31 nursing homes in Washington state	range 72 to 98	Not reported	44.8%	Dentate residents: oral problems: 72% poor oral hygiene 36% root caries 26% coronal caries 24% retained root tips 18% significant tooth mobility 11% swelling, soft tissue lesions 10% dry mouth Edentulous residents: oral problems: 46% loose dentures 18% sore or bleeding gums 15% poor oral hygiene 10% dry mouth 5.4% soft tissue lesions 63.8% had dental treatment needs

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including coronal and root caries, periodontal diseases, oral cancer, oral-facial pain, tooth loss, salivary gland dysfunction, and oral mucosal diseases:

- How do we best identify elders at greatest risk for oral diseases? Who is not at risk? How can we improve diagnostic accuracy? When is increased accuracy not related to improved outcomes?

- Can these diseases be prevented or delayed? Which measures are most effective? Which have the greatest benefit for the least cost?

- Once a person has the disease, which treatments are most effective?

When measuring effectiveness, care should be taken to consider the proximal outcomes, that is, effects at the tissue level, as well as ultimate outcomes, that is, how the overall effects of the treatment affect a person's ability to function and be a productive, contributing member of society.

An important consideration in treating oral health problems in the elderly is the relationship between oral and general health. Too often, oral health care is ignored or takes second place in light of the high prevalence of such chronic and life-threatening conditions as heart disease, stroke, cancer, osteoporosis, and diabetes. Yet the evidence presented in Chapter 5 speaks to associations linking oral infectious diseases such as periodontitis to the increased risk for cardiovascular, cerebrovascular, and lung disease, to exacerbations of diabetes, and as an early indicator of osteoporosis. In turn, to ignore oral health care in the course of cancer radiation and chemotherapy predisposes the patient to serious oral infections, mucositis, severe pain, bone loss, and potential abscesses. The 1988 Surgeon General's Workshop on Health Promotion and Aging stated that all health care providers should be educated in the importance of oral health to overall health and well-being (USDHHS 1988).

Insurance Issues. In light of the oral care needs of the elderly and their vulnerability to systemic diseases, the lack of dental insurance poses a serious barrier (Jones et al. 1990, Niessen 1984). Medicare funds cover only a negligible and select amount of care. Many elders lose their dental insurance at retirement (Niessen 1984). The situation may be worse for older women. Because women overall have lower incomes than men, lack of insurance and high copayments for dental services may represent formidable obstacles to care. In addition, women assume a disproportionate burden as caregivers for family members of all ages: the young, the sick, and the elderly (Niessen 1984). This often disrupts employment and, consequently, insurance coverage.

Thus, the majority of dental care rendered to older patients is paid for out of pocket. Medicaid programs fund dental care for low-income and disabled adults, including elders, in some but not all states (ADA 1998b, Jones et al. 1990), but reimbursements are scant, even in emergency situations. Where there is reimbursement, it is often low and slow, adding yet another disincentive for provision of oral care. Medicaid funds the costs of the majority of patients in long-term care, which means that they either have spent their life earnings or were in poverty prior to admission.

This lack of dental coverage is occurring at a time when more and more of the new elderly will be dentate and both want and need care (Ettinger and Beck 1982). Thus, funding dental care for elders is a major obstacle.

Social Services. Decreased functional status and increasing levels of dependence add barriers to dental care for elders. It will be increasingly important for community and social service programs to respond to older residents' needs for assistance, including transportation to meet their oral care needs. For example, programs administered by the Administration on Aging (AOA) that integrate oral health into general health programs for the elderly raise awareness about the benefits of good oral health and its contribution to nutritional status and quality of life (National Policy and Resource Center 1998). For patients in long-term care settings, access to dental care is even more problematic. Lack of adequate compensation has been a barrier to increasing the number of dentists who choose to pursue this type of dental practice.

Trends

Despite advances in modern medicine that have greatly increased life expectancy in the twentieth century, there will be an increase in the number of persons with acute and chronic diseases, including arthritis, diabetes, osteoporosis, and senile dementia (U.S. Bureau of the Census 1998b). As always, it is necessary to distinguish between healthy elders who age normally and remain active and community dwelling and the frail elderly (Niessen and Jones 1991).

Most community-dwelling elders take both prescription and over-the-counter drugs (Chrischilles et al. 1992). Approximately 30 percent of all medications prescribed in the United States are for persons over the age of 65, with an average of 8.1 medications per patient in a long-term care facility (Gurwitz et al. 1990, Lamy 1989). Seventy-five to 94 percent of

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patients taking medications are taking at least one drug that may have an oral side effect (Baker et al. 1991, Levy et al. 1988, Lewis et al. 1993). The most common of these side effects is dry mouth, or xerostomia. Others include abnormal homeostasis, soft tissue lesions or reactions, taste changes, altered host resistance, gingival overgrowth, burning oral sensations, increased caries due to high sugar content, and involuntary oral movements.

At any given time, approximately 5 percent of the population 65 and older live in a long-term care facility, and an estimated 43 percent of these elders will require long-term care placement at some point in their lives (Murtaugh et al. 1990). As discussed earlier, one result of elders' increased disability and dependency is that middle-aged family members are confronted with increased parental care concerns and needs (U.S. Bureau of the Census 1990).

Determining the oral health status of homebound and hospice populations is challenging. Statistics are reported by evaluating persons who seek services for either home or hospice care. Obviously, this underrepresents both populations by leaving out those who refuse, are not aware of, or do not qualify for services. As with long-term care, most homebound are women, although the average age is younger than for those in long-term care facilities. This may represent a step in the continuum of care before long-term care is necessary. Fifty-five percent

of women are hospice patients, and hospice patients are a much younger population than either the homebound or those in long-term care.

Table 10.8 lists the 10 chronic conditions seen most frequently in the frail elderly. These health problems are important in relation to oral health because they, or their treatments, may worsen oral health or in turn be worsened in the presence of oral disease (see Chapter 5). Long-term care residents have an average of 3.3 chronic conditions per person (Adams and Marano 1995).

Although it is difficult to evaluate dementia patients following strict research protocol, several studies have noted high caries rates, poor oral hygiene, and a high percentage with unmet dental needs (Chapman and Shar 1991, Gordon 1988, Jones et al. 1993). Patients with dementia depend heavily on caregivers to provide daily oral care, and dental care can be most challenging.

The Impact on Women

Redford (1993) examined the effects of biological, behavioral, and societal factors on women's oral and general health and treatment needs. Throughout their lives, American women report more acute symptoms, chronic conditions, and short- and long-term disabilities than men; women's activities are limited by health problems 25 percent more days each year than men's (Verbrugge 1984, 1990). The

TABLE 10.8
Most common diagnoses of frail elderly (≥ 65) in nursing homes, receiving home health (homebound) and hospice care by percentage of the population, 1994 to 1995

Rank	Nursing Home Resident	Homebound	Hospice
1	Diseases of circulatory system	Diseases of the circulatory system	Neoplasms
2	Mental disorders	Endocrine, nutritional, metabolic, and immunity disorders	Diseases of the circulatory system
3	Diseases of nervous system and sense organs	Diseases of musculoskeletal and connective tissue systems	Diseases of the nervous system and sense organs
4	Injury and poisoning	Injury and poisoning	Diseases of the respiratory system
5	Endocrine, nutritional, metabolic, and immunity disorders	Diseases of the respiratory system	All other diagnoses
6	Diseases of the respiratory system	Neoplasms	AIDS and infectious or parasitic diseases ^a
7	Diseases of the musculoskeletal and connective tissue systems	Ill-defined conditions	AIDS and infectious or parasitic diseases ^a
8	Diseases of the digestive system	Diseases of nervous system and sense organs	
9	Diseases of the genitourinary system	Disease of skin and subcutaneous tissue	
10	Neoplasms	Diseases of the digestive system	

^a Rates of the two categories are equal.

Sources: Data are from 1994 Home and Hospice Care Survey and 1995 National Nursing Home Survey (Dey 1996, 1997, Haupt 1997).

“gender gap” in physical disability widens with advancing age (U.S. Bureau of the Census 1990). Women in nursing homes or personal care facilities outnumber men three to one (NCHS 1991).

In the course of aging, significant numbers of women experience compromised functional status, physical confinement, medical conditions, and cognitive impairments. The literature indicates that these factors have placed women’s oral health at risk. At the same time, they may limit a woman’s ability to maintain oral hygiene self-care regimens, seek professional dental services, tolerate dental treatment, and comply with postoperative instructions (Gift 1998).

Pharmacologic regimens common among women can promote xerostomia, thereby increasing the risk of caries, periodontal diseases, and atrophic/disease changes in oral mucosa (Atkinson and Fox 1992). As a consequence of chemotherapy for breast cancer, women may suffer inflammation and ulceration of the oral mucosa, oral infection, hemorrhage, neurotoxicity, and salivary gland dysfunction (McCarthy and Skillings 1992, National Institutes of Health Consensus Development Conference Statement: Oral Implications of Cancer Therapies 1990).

ACHIEVING ORAL HEALTH THROUGHOUT LIFE

Each life stage brings a unique set of issues and considerations. Ultimately, this overview identifies the need for research on health services, health promotion, and disease prevention specific to populations at different life stages and throughout the life span. Our nation’s young and old exemplify the complexities of the individual, family, community, and institutional interactions that shape health and well-being. The middle years are not without complexities, but represent a

time during which employment and responsibility for caring for others play a critical role. Overlying the age spectrum are other sociodemographic factors that intensify the need to address each group and each health issue in a manner that optimizes health outcomes. In the overview of special populations presented in Chapter 4, the impact of race and ethnicity, socioeconomic status, and issues in relation to the health of women and individuals with disabilities clearly cut across all life stages. The nation’s social and welfare programs, the organization of our private systems of health care, and the values of the many cultures that make up America contribute to

TABLE 10.9
Summary: Healthy People 2010 objectives—oral health

Objective	Age(s)	2010 Baseline	2010 Goal
21.1 Reduce dental caries experience in children	2-4	18%	11%
	6-8	42%	
	15	51%	
21.2 Reduce untreated dental decay in children and adults	2-4	16%	9%
	6-8	29%	
	15	20%	
	35-44	15%	
21.3 Increase adults with teeth who have never lost a tooth	35-44	31%	42%
21.4 Reduce adults who have lost all their teeth	65-74	26% ^a	20%
21.5a Reduce gingivitis among adults	35-44	48%	41%
21.5b Reduce periodontal disease among adults	35-44	22%	14%
21.6 Increase detection of Stage I oral cancer lesions	all	35%	50%
21.7 Increase number of oral cancer examinations	40+	9%	35%
21.8 Increase sealants in 8-year-old first molars and in 14-year-old first and second molars	8	23% (a 1st)	50%
	14	15% (a 1st&2nd)	50%
21.9 Increase persons on public water receiving fluoridated H ₂ O	all	62%	75%
21.10 Increase utilization of oral health (OH) system	2+	44%	56%
21.11 Increase preventive dental services for poor children	2-17	20%	57%
21.12 Increase number of school-based Health Centers with OH component	K-12	developmental unknown	
21.13 Increase number of Community Health Centers and local health departments with OH component	all	56%	75%
21.14 Increase utilization of dental service for those in long-term facilities, e.g., nursing homes	all	17%	25%
21.15 Increase states with system for recording and referring orofacial clefts	all	23	51
21.16 Increase the number of states with state-based surveillance systems	all	0	51
21.17 Increase the number of state and local dental programs with public health trained directors	all	developmental unknown	

^aBased on self-report, National Health Interview Survey, 1996 (NCHS 1996).
Source: USDHHS 2000.

the current status of health, including oral health, and are the basis for further improvements.

The models described at the beginning of this chapter provide a structure for designing strategies to improve and promote health. Any one approach can be used as a framework for action. The Healthy People 2010 objectives provide a useful template for driving many age-specific and disease/condition-specific outcomes. The multiple oral-health-related objectives outlined there emphasize the importance of risk behaviors and comorbidities that need to be addressed in order to further improve oral, dental, and craniofacial health (USDHHS 2000) (Table 10.9).

Recurrent themes in this chapter and other parts of the report underscore the importance of access to health care and health care services, the adoption of healthy behaviors, and the role of individuals and all health care providers in contributing to oral health. Public policies, institutional care guidelines, and community programs can reinforce what individuals can do by providing a health-promoting environment. Toward that end, a recently published report from the Center for Policy Alternatives (Warren 1999) examines and recommends health policies and related actions to improve the oral health status of the poor and underserved. Focus is placed on five dimensions of oral health—finance, sustainability of services, capacity to provide services, cultural competency of care providers, and infrastructure to support professional practice. Policy recommendations and proposed action steps are presented in terms of the availability, accessibility, and acceptability of care. Dental care services are emphasized over other aspects of oral health maintenance, because much of the unmet need warrants dental services for prevention and treatment.

Health care providers, program administrators, local, state, and government administrators, educators, scientists, and leaders, among others, have proposed ways of promoting health and preventing disease that respond to the principal health determinants presented in the chapter. Thus, efforts can be directed toward changing the environment to make it more life-enhancing; establishing new public health policies; enhancing health literacy to encourage healthy behaviors and lifestyles; working at the microlevel of neighborhoods and communities on health-related measures; and orienting health care to meet the needs of a changing society.

Building on programs and structures already in place that have contributed to the improvements in oral health is essential. Further advances in the oral health of all Americans cannot be made unless the health needs of the underserved and vulnerable pop-

ulations are addressed. The inability of federal and state programs that are the primary source of funding for services to these populations, specifically, Medicaid, SCHIP, and Medicare, to cover and adequately reimburse for dental services has been duly noted. The current review of access to dental care by the Government Accounting Office should add to an earlier review of EPSDT and further address barriers to access and other issues that warrant attention. The Institute of Medicine (IOM) study on the extension of Medicare services to include medically necessary dental services is an additional source of recommendations to better address the health needs of vulnerable populations and enhance health overall (Field et al. 1999).

Other critical reviews of the problems entailed in addressing the nation's oral health needs and proposing solutions include the 1989 Public Health Service Workshop on the Oral Health of Mothers and Children (USDHHS 1989). Recommendations covered the areas of public education, professional education, coalitions, advocacy and collaboration, health policy, and data collection, evaluation, and research. These recommendations formed the basis for the 2000 Surgeon General's Workshop on Children and Oral Health. Similarly, the 1988 Surgeon General's Workshop on Health Promotion and Aging (USDHHS 1988) provided guidance for steps to be taken to improve the oral health of the nation's elders, all of which are still relevant. This workshop provided the impetus to add objectives on oral health status in nursing homes to Healthy People 1990.

Ideally, organizations and agencies working together can resolve the issue of barriers to care. Concentrated efforts such as those focused on improving the access of children to Medicaid oral health services by the Health Care Financing Administration, Health Resources and Services Administration, American Dental Association, and National Center for Education in Maternal and Child Health are an example of how national organizations can unite to make a difference. Still, activities are needed at the local community level. The efforts of Milgrom and colleagues provide one such example for children eligible for Medicaid, with a focus on early childhood caries (Milgrom and Weinstein 1999, Milgrom et al. 1999). In implementing these efforts, however, the capacity of current national, state, and local programs as well as legislative mandates to meet the oral health needs of all Americans must be reviewed and strengthened, as necessary.

FINDINGS

- The major factors that determine oral and general health and well-being are individual biology and genetics; the environment, including its physical and socioeconomic aspects; personal behaviors and lifestyle; access to care; and the organization of health care. These factors interact over the life span and determine the health of individuals, population groups, and communities—from neighborhoods to nations.
- The burden of oral diseases and conditions is disproportionately borne by individuals with low socioeconomic status at each life stage and by those who are vulnerable because of poor general health.
- Access to care makes a difference. A complex set of factors underlies access to care and includes the need to have an informed public and policymakers, integrated and culturally competent programs, and resources to pay and reimburse for the care. Among other factors, the availability of insurance increases access to care.
- Preventive interventions, such as protective head and mouth gear and dental sealants, exist but are not uniformly used or reinforced.
- Nursing homes and other long-term care institutions have limited capacity to deliver needed oral health services to their residents, most of whom are at increased risk for oral diseases.
- Anticipatory guidance and risk assessment and management facilitate care for children and for the elderly.
- Federal and state assistance programs for selected oral health services exist; however, the scope of services is severely limited, and their reimbursement level for oral health services is low compared to the usual fee for care.

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Facing the Future

The challenges for oral health in the twenty-first century are formidable. First and foremost is the need to ensure that all people have access to health care and can acquire the health literacy necessary to make use of health promotion and disease prevention information and activities.

The century offers the promise of a new era for health wrought by the convergence of six cultural movements, any one of which would be sufficient to transform the human condition:

- The biological and biotechnology revolutions.
- A redistribution of the world's people by rapid and sizable migrations within countries and across borders.
- Changing demographics in industrialized as well as developing nations.
- Changing patterns of disease, including the emergence and reemergence of infectious diseases, and changes in the organization of health care.
- Instant worldwide communication through the Internet, cable, satellite, and wireless technology.
- A continuing exponential rate of growth in information technology, specifically in computer speed, memory, and complexity.

These global currents are changing the way we live now and will have profound implications for the future of the oral and general health and well-being of all people.

THE PAST AND PRESENT AS PROLOGUE

The Pioneers

The history and intellectual activity of the eighteenth and nineteenth centuries set the seeds for the flowering of biology in the twentieth and early twenty-first centuries (Porter 1997). The scientific and techno-

logical discoveries of the early anatomists and embryologists—the founders of cell theory and brain research—were followed by the brilliant innovations of Pasteur, Koch, and Ehrlich, who established the new fields of microbiology and immunology. The cumulative achievements of these pioneers set the foundation for the diagnostic and therapeutic science and art of dentistry, medicine, nursing, and pharmacology in the twentieth century.

The seeds were also sown for the convergence of chemistry, physics, and biology in the field of molecular biology, as well as the convergence of Darwinism, fruit fly genetics, and population genetics into the modern evolutionary synthesis. These convergences inspired the current quest to identify all 100,000 genes of the human genome and to assign functional meanings to the motifs that are encoded within them.

Vital Statistics

The growth of the world population and the transcontinental movements of people are proving a dominant force for change. The twentieth century began with increased European and Asian migrations to the United States. By 1900 the U.S. population had reached 90 million residents and the Earth's population was approaching 1 billion people. Life expectancy in the United States was 47 years of age. Acute viral and bacterial infections were the primary causes of infant morbidity and mortality. Being edentulous, or "toothless," was a normal expectation for mature adults.

For most of recorded human history and the 100,000 years of human prehistory, life expectancy was very low. Life expectancy at the time of the Roman Empire was approximately 28 years of age. From the beginning of the first millennium A.D. to 1900, each year of history saw an average gain of 3 days in life expectancy. Each year since 1900,